

# **The Presentation of Spatial Design using Autonomous Behavior in Virtual Environments**

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## **Abstract**

This research is an exploration of virtual environments as it relates to presenting spatial design, specifically focusing on the use of autonomous behavior in virtual characters for simulation purposes. The characters in motion gives the viewer of this environment an understanding of circulation routes, traffic density and space usage (function) among other aspects. Since the characters can ‘think’ by themselves through the programmed artificial intelligence, the resulting simulation may be unexpected. Flaws or miscalculations in the design can be highlighted due to the chaos that arises from the virtual crowd.

To conduct the research, two virtual environments were produced and examined. These were modified through an iterative process based on analysis and review by groups of peers, academics, as well as designers in the field. My documentation includes the necessary steps taken prior to production, an analysis of the environments, as well as possible future directions. The existing uses of this technology were also analyzed and compared.

Similar to the impact on the design field by the introduction of perspective drawings, the use of virtual environments has the potential of creating a new method of designing, one where design is conceived and experimented on a computer, as opposed to orthographic drawings and perspective vignettes. This is due to the ability of real-time spatial manipulation which allows one to see the direct effect of any proposed change upon the characters in the simulation. One could experience the environment through these autonomous beings, giving us a dimension of sight we could never see otherwise. The functionality of designed space could now be

‘discovered’ by the virtual characters, thus enabling the most ambiguous forms to take on roles we may not have conceived ourselves.

## **Introduction**

There are some inherent disadvantages in the traditional methods of presenting spatial design. The use of multiple sets of information, like orthographic drawings and physical models, require the viewer to correlate various bits of information and mentally reconstruct a space (Ching 1998). Aspects of circulation and function then need to be imagined by this viewer. This, clearly, can be an issue especially when the viewer is not trained in the field of spatial design and visualization. Even for experienced designers, the means of representing a space is static while spatial design is dynamic (Gargus 1994).

The use of virtual environments for presentation purposes can allow for a dynamic model that incorporates visually articulated layers of information that work in conjunction with each other. The unrestricted time, space, and dimension that virtual environments can offer allows for one to experience the space relatively closer to how we would do so in our daily life. The presentation can be enhanced with the use of virtual characters that could help ‘narrate’ the design. Viewing a character walking through a space immediately gives us an understanding of the scale, function, circulation routes, and traffic density. By applying a level of autonomous behavior to these characters, we can produce possible scenarios of a space that we may not have thought up ourselves, potentially sparking new ideas for the viewer. Besides a communication tool, the virtual environment could essentially serve as a test bed to make informed decisions.

## **Methodology and Procedure**

To explore the possibilities of autonomous characters in virtual environments for presenting spatial design, a few virtual environments were built from ground up, keeping in mind the design considerations that would concern a spatial designer. There were three stages in this exploration:

First, the path-finding capability of the characters needed to be produced. The background research and trialing took place in this stage. Defining what role the character will serve, what information should be provided to this character and their behavior to one another were all concerns that were addressed. After a series of experiments, a path-finding system was found and implemented. This stage resulted in a firm understanding of the most fundamental aspect of this research: autonomous behavior.

The second step was to apply the path-finding capability in a real world scenario. Virtual office workers were spawned in an office park. They were to head to one or more locations of a nearby café and utilize the space accordingly. To better track the movement, every character emitted a particle trail that would disappear over time (figure A). The resulting visualization clearly depicts the circulation routes and traffic density. I quickly discovered that it was nearly impossible to perfectly emulate a real-world scenario without statistics or and with the lack of human psychology factors. It is important to state that the creation of a perfect scenario is not necessary since the simulation still assists in the conceptual narrative of the space.

The last part of the process was an advancement of a specific aspect of the virtual environment. Even while seeing people in motion, utilizing a space, we must speculate their experience. In this stage, we are able to fixate ourselves onto any character in the virtual

environment (figure B). This again gives us a different and very interesting dimension of viewing.

Issues of the virtual model, camera, materiality, and interface were dealt at every stage. Self analysis, review by peers, and analysis of other works like computer games, were critical in developing the later iterations.

### **Assessment and Discussion**

One aspect learned from doing this process was forcing the designer to contemplate the rest of the design. For example, a designer texturing their virtual model becomes obligated to consider materiality. Decisions need to be made that may not have been resolved. Modeling a space forces one to consider the entire form, not just the look of the form from a couple views (plan, section). Producing a virtual environment has a similar effect to the design process.

In this regard, virtual environments are only a few steps from becoming common to the field, something that has already taken place with the Building Information Model (BIM). BIM is essentially a comprehensive virtual model built up of layers of information from across the construction disciplines. Most importantly, the BIM is fully 3-dimensional and is put in digital form early in the design development phase (Gonchar 2007). The addition of baked textures, animated characters, and their programmed artificial intelligence would allow for a virtual environment produced in this study.

The simulation in this study has much more potential than to serve just an observation tool. For example, examining the consequences of user controlled disaster, such as a fire or hostage crisis, can be incredibly valuable. An even more daunting task is to manipulate the architecture in real-time. This way we could find the exact cause and effect on the character's circulation patterns. In

essence, we could find the possible effect of every spatial design-related decision one could make.

The discovery of perspective drawings changed the way designers see space, subsequently, changing the way we design (Porter 1997). In this way, a new style of building form comes into being. This is obvious from Frank Gehry's work who could not have designed some of his buildings without the aid of a computer (Fazio et. Al. 2004). There is a parallel between the discovery and implementation of perspective drawings and virtual environments to the field of spatial design. Virtual environments offer a different mode of visualization and allows for a change in the way we design. An example of the latter is the virtual environment for conceptual design produced at the University of Minnesota where the developer was able to design while sitting inside the space (Anderson et. al. 2003). In short, the use of virtual environments could alter the form and functionality of the contemporary building.

Another such way this can happen is by the use of the virtual character's to find for themselves what the space can be used for. Programmed appropriately, the characters can potentially use a heap of what seems to be 'junk', giving us insight into more ambiguous forms. This in effect would make virtual environments a tool for designing as well as communication and analysis.

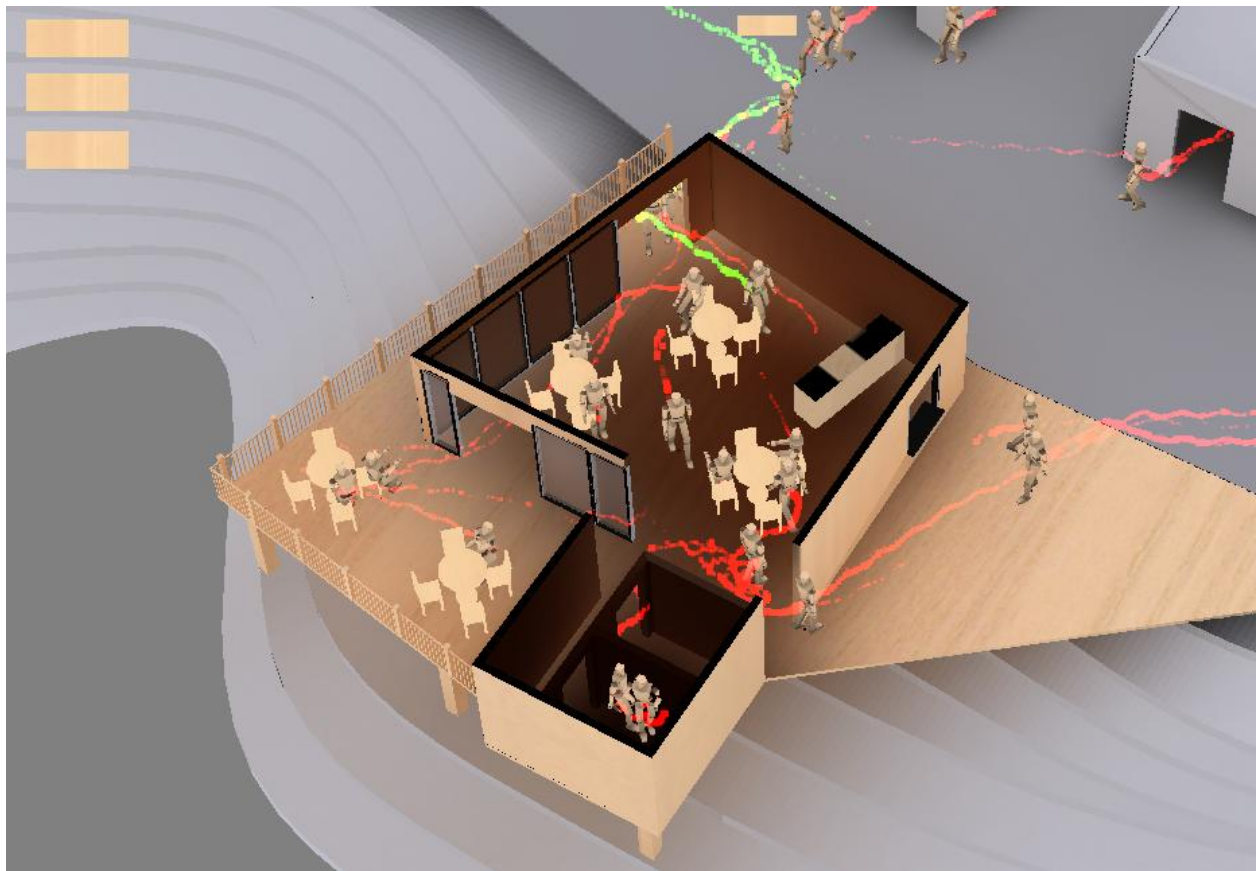


Figure A

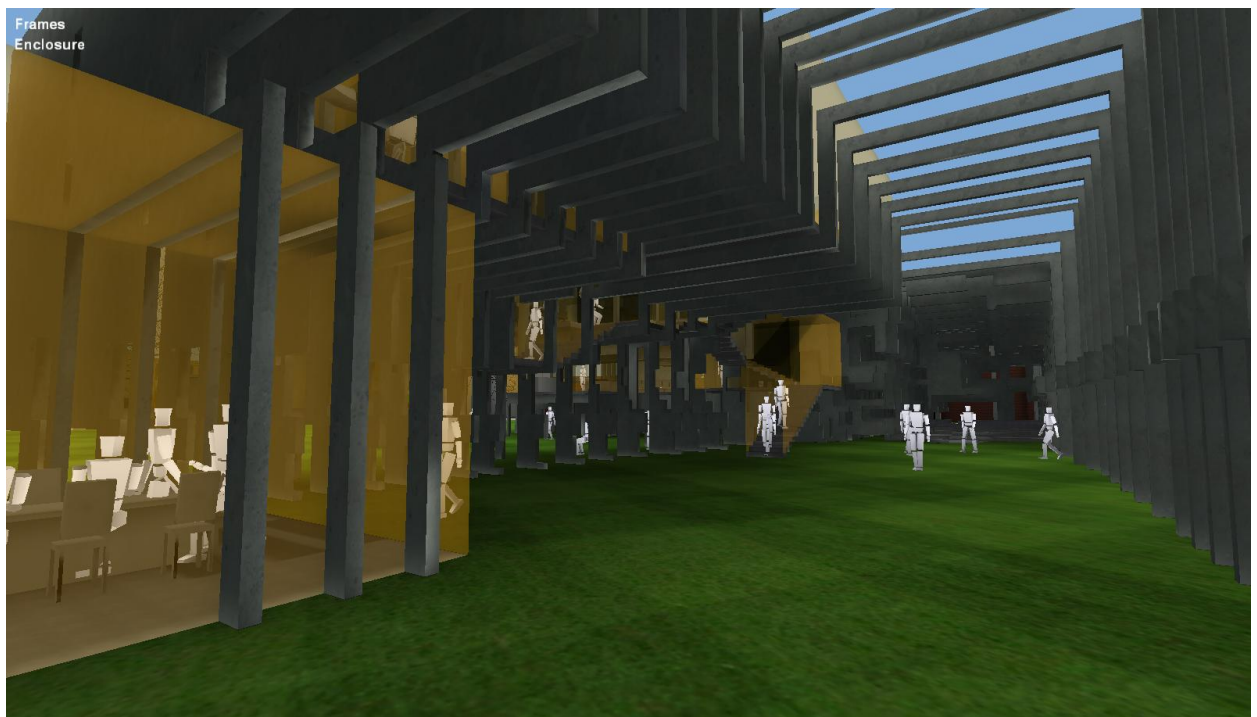


Figure B

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